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Perspective

COVID-19 waste management: Effective and successful measures in Wuhan, China



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The COVID-19 pandemic and governmental policies to contain the spread of virus have caused a global economic recession and have also generated an enormous amount of medical waste. The composition was greatly influenced by disposable plastic-based personal protective equipment (PPE) and single-use plastics by online shopping for most of the basic necessity. The use of PPEs and single-use plastics during the pandemic not only increases the quantity of medical waste but also alters the average density of the medical waste. Waste generation amid COVID-19, especially discarded PPEs and single-use plastics, has been an environmental and public health crisis around the world particularly in the countries with developing economies and those in transition. Safe solid waste management is already a matter of major concern to these countries where safe and sustainable practice is scarce and healthcare waste has not been adequately regulated (Singh et al., 2020). The current rapid surge in healthcare waste due to the COVID-19 pandemic is further exacerbating the problem and there is an immediate threat that the impacts of unsafe disposal of healthcare waste will spill over into a crisis of environmental pollution. Unsafe disposal of healthcare waste not only pollutes the environment but also conduces to the spread of infectious diseases such as Hepatitis, HIV/AIDS, cholera, typhoid and respiratory complications, which are mainly caused by the reusing of the disposal medical equipment or by scavenging the medical waste, as reported in different countries (WHO, 2018). By considering the sudden surge in the healthcare waste generation, we explored the effective experiences and lessons from COVID-19 led waste management in Wuhan, China, that are potentially helpful strategies for many developing countries where COVID-19 is still expanding and causing a huge amount of healthcare waste generation.

Generally, discarded healthcare waste and other forms of clinical waste are disposed of in a sanitary landfill or incinerated in the form of waste to energy recovery. However, in many developing countries, healthcare wastes along with the municipal solid waste are dumped in the open or in poorly managed landfills where the movements of waste pickers and livestock such as dogs, goats, and cows often have been noticed (Nzediegwu and Chang, 2020). A few countries also applied advanced technology to treat their medical waste by steam-sterilized or chemically disinfected, but they are exceptional. Although many

developed countries have shown good management of COVID-19-led medical waste, China, similar to many countries with developing economies and those in transition, has shown effective and successful measures against the COVID-19-led medical waste management. Since 2003, after the Severe Acute Respiratory Syndrome (SARS) breakout in the region, more than 30 legislative orders and emergency management orders on environmentally sound management of medical waste have been implemented in China. The lesson and successful measures in Wuhan and other parts of China gained from SARS and COVID-19-led medical waste management could be a piece of valuable information for the many developing countries coping with a sudden increase in the medical waste.

The city of Wuhan in China generated nearly 247 tons of medical waste per day at the peak of the pandemic, nearly six times more than before the pandemic. The peak occurred from 15 February to 15 March (Singh et al., 2020). Before the COVID-19 outbreak, the city has about 50 tons per day of medical waste disposal capacity with an average output of 45 tons (Wei, 2020). This capacity was solely based on an incineration plant which normally operated 24/7, without any extra reserved or storage disposal capacity for medical waste management. With the rise in the cases of COVID-19 in the city, the output of the medical waste also increased to 110–150 tons per day in mid-Feb and kept increasing up to 247 tons per day at the peak of outbreak until March 15, afterward it gradually declined back to normal in mid-May. After the third weeks of January, when local authority realized that the medical waste was running out of the existing capacity to safely disposed of the rising amount of medical waste, they searched for the strategies from different levels of experts and decided to involve four companies specialized in solid waste management including Gient, which claimed to have built a 30 tons/day capacity emergency treatment plant by Feb 22 to treat around 25% of total medical wastes generated in the city during the COVID-19 pandemic (Wei, 2020).

The local government had officially declared the lockdown and social distancing policies in the city from January 23 to March 8, 2020. During this period, the generation of medical wastes far exceeded the capability of existing treatment/disposal plants in the city, thereby, a huge amount of medical waste piled up in the health institutions and

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was stored for a few days to be disposed of promptly. This led to the local waste management authority to deploy the mobile incinerators in the city of 11 million people to safely dispose of the mounting number of discarded PPEs such as face masks, gloves, and other contaminated single-use protective gear. Besides, the local authority had also taken a few strict measures to safely disposed of the mounting amount of medical waste based on national laws and regulations and if the act was disobeyed by any management system, the corresponding unite was penalized accordingly. (Chen and Guo, 2020)

According to the government reports, about 50,333 confirmed cases of COVID-19 were reported in the city of Wuhan. The data released from companies involved in the city's medical waste management, reported that the city has around 90,000 beds in hospitals and clinics including 54,000 beds in large hospitals, 14,000 beds used by COVID-19 patients only, and 20,000 beds in newly built temporary hospitals (Wei, 2020). The wastes generated from quarantine centers and self-isolation areas were not officially quantified as medical wastes but the wastes generated from potential suspected household and quarantine areas were safely collected and properly disposed of as medical wastes. The report shows that China's national medical waste disposal capacity increased to 6066.8 tons/day as of March 21, 2020, compared to 4902.8 tons/day before the pandemic. In Wuhan city, it was achieved to 265.6 tons/day from 50 tons/day before the pandemic. (Chen and Guo, 2020)

The key takeaway from the experience and lessons of medical waste management during the COVID-19 outbreak in Wuhan are: 1) Development of a comprehensive disposal mode which includes the combination of centralized disposal and on-site emergency disposal of medical waste. This process led all districts of the city to utilize the various emergency disposal equipment such as incineration apparatus, mobile treatment equipment, domestic incineration furnace, and industrial kiln for medical waste disposal. Besides adequate storage and reserved capacity of medical waste treatment facilities is crucial, which can prevent the pilling-up of the waste generated in the emergency period such as COVID-19.

Changes in medical waste disposal technology. During the outbreak in Wuhan, three main changes were observed: from decentralization to centralization, from irregular to regular management, and from mostly incineration to non-incineration disposal technologies such as autoclave steam, dry heat, chemical disinfection or microwave.

The treatment facilities for medical waste should be more automated and based on the technology of the Internet of Things (IoT), with

a minimum of workers involved. Through the technology of IoT, the whole process of the medical waste disposal was made a real-time tracking and controlling process in the city of Wuhan. The goals of making automatic processes and the use of minimum workers for the infectious waste were also realized through the technology of IoT that includes sensing equipment information, location system, scanning devices and video surveillance, and Internet access with each device.

Larger capacities of mobile facilities should be maintained, particularly during the pandemic, which can be very important for the developing countries where the medical waste disposal facilities are limited. The mobile facilities are not only convenient for the emergency situation but can also be used as a strategic backup capacity for a state in the future as well.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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